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Inelastic Neutron Scatterings Reveal Intense Ferromagnetic Fluctuations Preceding Magnetoelastic First-Order Transitions in LaFe13–xSix

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First-order magnetic transitions are of both fundamental and technological interest. Of particular interest are giant magnetocaloric effects, which are attributed to first-order magnetic transitions and have attracted great attention for solid-state refrigeration applications. Here, we present a systematic study, with inelastic and quasielastic neutron scatterings, on the lattice and spin dynamics in intermetallic LaFe11.6Si1.4 and LaFe11.2Si1.8, which represent one of the most classical giant magnetocaloric systems and undergo first-order and second-order magnetic transitions, respectively. While the two samples show similar spin-phonon coupling effect, LaFe11.6Si1.4 exhibits a much stronger magnetic diffuse scattering in the paramagnetic state preceding its first-order magnetic transition, correlating closely to picosecond ferromagnetic fluctuations. These dynamic insights suggest that the spin dynamics dominate the magnetoelastic transition and ferromagnetic fluctuations may be universally relevant for magnetocaloric materials [1].

[1] Zhao Zhang, et al. PHYSICAL REVIEW MATERIALS 5, L071401 (2021).

Level of Expertise

Expert

Presenter Gender

Man

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He/Him

Which facility did you use for your research

Australian Centre for Neutron Scattering

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No

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Yes

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